Physics News Update
The AIP Bulletin of Physics News

Number 670 #1, January 22, 2004 by Phil Schewe, James Riordon, and Ben Stein

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Extreme Ultraviolet from Argon

Physicists in Colorado have gotten argon ions to send out coherent light with an energy of 250 electron volts, almost twice the energy previously achieved with argon. This energetic light, in the extreme ultraviolet (or soft x-ray) portion of the electromagnetic spectrum, might be useful in support of future lithographical patterning of higher-density microchips.

The process used to produce the light is called high-order harmonic generation: light at visible wavelengths enters a sample of helium atoms and temporarily strips the outer electron from the atom. This electron then quickly rejoins its atom, emitting a higher-energy (harmonic) photon in phase with the original light.

In other words, the atom is being used as a machine for converting visible light into higher-energy light. The atoms sit in a waveguide which helps to keep the emerging laser light focused, particularly in the plasma created when the electron is ripped from the atom and does not recombine with it.

Noble gas atoms are ideal for this harmonic process since their outer electrons are grasped tightly, but if they can be surrendered, they will render up a prized high-energy photon upon their turn home.

Helium (the smallest noble element) emits harmonic photons at energies even higher than that achieved now with argon, but it does so very grudgingly.

Argon is generally chosen because the harmonic conversion of light is much more efficient. But in the past, the x-ray photon energy was lower. This new work has the potential to make efficient, compact x-ray sources at higher energies than was previously possible.

According to Emily Gibson (303-492-7766, gibsone@jilau1.colorado.edu), a member of the JILA-Colorado-NIST team of researchers (Margaret Murnane, Henry Capteyn, *et al.*) doing the argon work, the new source of coherent soft x-ray light will be important for nm-scale imaging, including biological imaging and surface science. (Gibson *et al.*, *Physical Review Letters*, 23 January 2004

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